

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
18 October 2001 (18.10.2001)

PCT

(10) International Publication Number  
**WO 01/77624 A3**

(51) International Patent Classification<sup>7</sup>: G01N 5/00, 15/06, 25/08

(21) International Application Number: PCT/US01/11037

(22) International Filing Date: 5 April 2001 (05.04.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
09/543,612 5 April 2000 (05.04.2000) US

(71) Applicant: THE CHARLES STARK DRAPER LABORATORY, INC. [US/US]; 555 Technology Square, Cambridge, MA 02139 (US).

(72) Inventors: CUNNINGHAM, Brian, T.; 23 Bedford Street, Lexington, MA 02420 (US). WILLIAMS, John, R.; 70 Outlook Drive, Lexington, MA 02421 (US).

(74) Agents: SHANSKE, Jason, D. et al.; Iandiorio & Teska, 260 Bear Hill Road, Waltham, MA 02451-1018 (US).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Declaration under Rule 4.17:**

— as to non-prejudicial disclosures or exceptions to lack of novelty (Rule 4.17(v)) for all designations

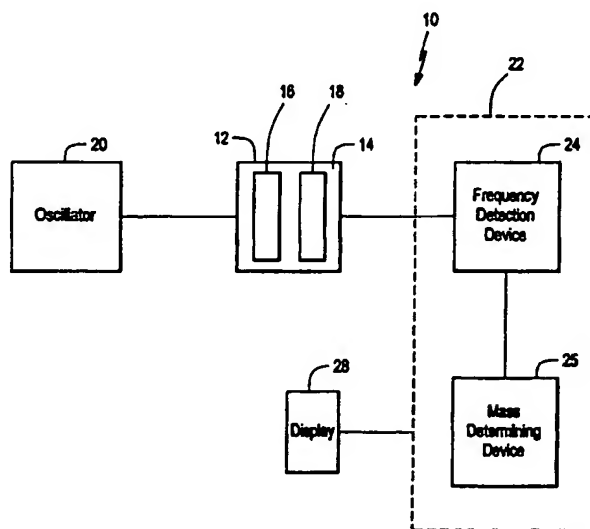
**Published:**

— with international search report

— with a declaration as to non-prejudicial disclosures or exceptions to lack of novelty

[Continued on next page]

(54) Title: APPARATUS AND METHOD FOR MEASURING THE MASS OF A SUBSTANCE



(57) Abstract: An apparatus (10) for measuring the mass of a substance includes a sensor (12) having a membrane layer (14), the membrane for receiving the substance thereon, an oscillator device (20) for driving the membrane at a reference resonant frequency, a frequency detection device (24) for determining a change in the reference resonant frequency caused by the presence of the substance on the membrane and a mass determining device (26) for determining the mass of the substance, the change in the reference resonant frequency being indicative of the mass of the substance. The apparatus may be used to determine the concentration of the substance within a volatile solution, to determine the moisture content of the substance, and to determine the boiling point of the substance.

WO 01/77624 A3



(88) Date of publication of the international search report:  
28 March 2002

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/11037

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) : G01N 5/00, 15/06, 25/08

US CL : 73/61.75, 73, 580; 374/27

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 73/19.03, 24.01, 24.06, 32A, 61.45, 61.49, 61.79, 61.75, 64.53, 73, 580; 374/16, 23, 27

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,212,988 A (WHITE et al.) 25 May 1993 (25 MAY 1993), entire document, especially col. 11, line 61 to col. 12, line 4; col. 14, line 62 to col. 15, line 16; and col. 18, lines 63-68.	1-7, 11-15, 17, 20, 21 23 ----- 8-10, 16, 18-19, 22
Y	US 5,918,258 A (BOWERS) 29 June 1999 (29.06.1999), col. 12, lines 18-28, and col. 14, lines 8-62.	8-10, 18-19, 22
Y	US 4,596,697 A (BALLATO) 24 June 1986 (24.06.1986), col. 1, lines 41-53.	16



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" Document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" Document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"G" Document member of the same patent family
"O" Document referring to an oral disclosure, use, exhibition or other means	
"P" Document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

13 SEPTEMBER 2001

Date of mailing of the international search report

23 OCT 2001

Name and mailing address of the ISA/US  
Commissioner of Patents and Trademarks  
Box PCT  
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

JOHN E. CHAPMAN

Telephone No. (703) 305-4926

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US01/11037

### BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING

This ISA found multiple inventions as follows:

See the "Invitation To Pay Additional Fees," mailed 06 August 2001. All Fee's were timely paid. For your convenience, the Lack of Unity is outlined below:

This application contains claims directed to more than one species of the generic invention. These species are deemed to lack Unity of Invention because they are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for more than one species to be searched, the appropriate additional search fees must be paid. The species are as follows:

Species I, Fig. 7 (determining concentration),  
Species II, Fig. 10 (determining moisture content), and  
Species III, Fig. 12 (determining boiling point).

The Groups of Claims are deemed to correspond to the Species listed above in the following manner:

Group I, claims 7-10, 18-19 and 22.  
Group II, claims 12-13, 15 and 20-21.  
Group III, claims 12, 14-15, and 20.

The following claims are generic: 1-6, 11, 16-17 and 23.

The species listed above do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, the species lack the same or corresponding special technical features for the following reasons: The inventions listed as Group I and II, the species are linked by generic claims 1 and 17, which claims are considered unpatentable over White et al. (U.S. Patent No. 5,212,988). White et al. discloses a plate wave resonator in Fig. 11a having a membrane layer 111 whose resonant frequency is determined by properties of the surrounding environment, including the mass of a loading fluid. Accordingly, the species are not linked by a common special technical feature.